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Preliminary Feasibility of Resource Recovery for the Cities of Oxford and Henderson, North Carolina

CSI Resource Systems, Inc.
Boston, MA

Prepared for

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The report presents the results of a preliminary determination of the feasibility of energy recovery for the Cities of Oxford and Henderson, North Carolina. The study contains the results of several site visits and interviews with personnel from these Cities including the Kerr-TAR Regional Council of Governments. First order estimates of waste quantity, an evaluation of the energy market potential, an assessment of solid waste management options, an examination of legal/institutional aspects and major tasks to be performed prior to committing to implementation of a resource recovery project were thoroughly addressed. Project economics for seven different modular combustion system with design capacities ranging from 100 TPD_5 to 200 TPD_5.

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A TECHNICAL ASSISTANCE PROGRAM REPORT

PRELIMINARY FEASIBILITY OF RESOURCE RECOVERY FOR THE CITIES OF OXFORD AND HENDERSON, NORTH CAROLINA

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Technical assistance by personnel teams. 42 USC 6913

RESOURCE RECOVERY AND CONSERVATION PANELS

SEC. 2003. The Administrator shall provide teams of personnel, including Federal, State, and local employees or contractors (hereinafter referred to as "Resource Conservation and Recovery Panels") to provide States and local governments upon request with technical assistance on solid waste management, resource recovery, and resource conservation. Such teams shall include technical, marketing, financial, and institutional specialists, and the services of such teams shall be provided without charge to States or local governments.

This report has been reviewed by the Project Officer, EPA, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

Project Officer: Elmer G. Cleveland

U.S. ENVIRONMENTAL PROTECTION AGENCY

TECHNICAL ASSISTANCE PROGRAM REPORT SERIES

PRELIMINARY FEASIBILITY OF RESOURCE RECOVERY FOR THE CITIES OF OXFORD AND HENDERSON, NORTH CAROLINA

PREPARED FOR

OFFICE OF SOLID WASTE MANAGEMENT

U.S. ENVIRONMENTAL PROTECTION AGENCY

REGION IV, ATLANTA, GEORGIA

BY

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January 1980

TABLE OF CONTENTS

	Page
TABLE OF CONTENTS	ii
PREFACE	iii
PROJECT PURPOSE	1
STUDY FINDINGS AND CONCLUSIONS	2
Principal Findings	2
Secondary Findings	3
Immediate Next Steps	4
Other Project Considerations	4
STUDY METHODOLOGY	6
Available Solid Waste	6
Potential Energy Customers and Appropriate Sites	7
Appropriate Technology	8
Competitive Economics	8
APPENDICES:	
APPENDIX A. ENERGY MARKET SURVEY FINDINGS	10
APPENDIX B. ECONOMICS OF RESOURCE RECOVERY OPTIONS	31

PREFACE

This report was prepared for the cities of Oxford and Henderson, North Carolina under the U. S. Environmental Protection Agency's Technical Assistance Program to state and local governments as a result of a request to EPA Region IV by the Kerr-Tar Regional Council of Governments.

This report contains the results of several site visits to Oxford and Henderson by CSI Resource Systems, Inc., and interviews with personnel from the cities of Oxford and Henderson and the Kerr-Tar Regional Council of Governments. As well, personal interviews were held with representatives of the eight largest industrial energy concerns within the area, and telephone conversations with another 12 firms, to determine whether potential energy markets existed.

Resource Systems is a technical assistance contractor to the Office of Solid and Hazardous Waste, U. S. EPA Region IV. Under the terms of the Technical Assistance Programs, the entire cost of Resource Systems' technical assistance activities on behalf of Oxford and Henderson was paid for by the U. S. EPA.

The report presents the results of a preliminary determination of the feasibility of energy recovery. Such determination involved development of first-order estimates of waste quantity generated by Oxford and Henderson and portions of Granville and Vance Counties in which the cities are located; evaluation of the market potential for energy recovery; development and assessment of alternative solid waste management options; examination of some of the legal and institutional aspects of resource recovery implementation; and identification of the major tasks remaining to be performed prior to committing to implementation of a resource recovery project.

Resource Systems wishes to thank especially the following individuals for their support and generous cooperation:

Mr. Jerry Moss, Acting City Manager of Henderson
Mr. Tom Ragland, City Manager of Oxford
Mr. Roy Williford, Planning Director, Kerr-Tar Regional Council of Governments

PROJECT PURPOSE

The Kerr-Tar Regional Council of Government initiated a request to the Environmental Protection Agency, Region IV, for technical assistance to evaluate the feasibility of resource recovery as a solid waste management option for the cities of Oxford and Henderson, North Carolina and surrounding areas of Vance and Granville Counties. The evaluation had two objectives: First, on a preliminary basis to determine the economic and technical feasibility of Oxford and/or Henderson undertaking a resource recovery project to convert solid waste resources into a useable energy form. Second, if the preliminary findings are positive, to identify those immediate next steps which should be performed prior to a commitment of significant additional resources for a comprehensive Feasibility Study.

Underlying the interest in a preliminary determination of the feasibility of energy recovery is the fact that solid waste represents a valuable alternative energy resource. The Cities of Oxford and Henderson (the principal cities of Granville and Vance Counties) combined generate an estimated 37,000 tons of municipal solid waste (MSW) annually. Typical higher heating value (HHV) estimates of 4500 Btu* per pound for municipal solid waste suggest that the energy value of each ton of MSW recovered is equivalent to nearly 62 gallons, or 1.4 barrels, of oil. Thus, the region currently discards in the form of MSW, the energy equivalent of nearly 52,000 barrels of oil per year. This lost energy is disposed of in two landfills: Oxford's solid waste at the Granville County owned and privately operated North Granville landfill, and Henderson's MSW at the County owned and operated Vance County landfill.

Recent OPEC production cutbacks and pricing decisions, which led to significant shortages and dramatic price increases in various petroleum products, have forced economists and energy experts to question both the future cost stability and availability of key petroleum-based products. As a result, the concept of recovering from the region's solid waste, marketable energy products has been given additional impetus.

Further, as the Vance County landfill is rapidly reaching its disposal capacity (and soon must be closed), resource recovery can both

*British Thermal Unit.

eliminate the need for locating a replacement disposal facility and extend the remaining life of the North Granville landfill. This extension in useful life is due to the fact that resource recovery substantially reduces the volume of waste to be landfilled.

STUDY FINDINGS AND CONCLUSIONS

The Preliminary Feasibility Study of Resource Recovery for Oxford and Henderson has produced a number of findings and conclusions. For purposes of presentation, these findings and conclusions are categorized into four groupings: principal findings, secondary findings, immediate next steps, and other project considerations.

Principal Findings

The principal findings emerging from the Preliminary Feasibility Study are:

- Several potential buyers of low pressure, process steam exist in Oxford and Henderson.
- The most promising of these potential buyers are located in the Oxford Industrial Park.
- The quantity and quality of steam used by these potential customers can be technically supplied through a 200 TPD_5* modular combustion system (MCS) with waste heat boilers.
- Steam can be produced and sold at an attractive price to these potential customers, and at the same time provide a favorable disposal cost to public participants in a recovery project. Projected 1983 disposal costs per ton for the 200 TPD_5 MCS are $5.50 compared to an estimated cost of $5.50 for continued reliance upon landfilling as the principal method of disposal.
- A modular combustion system (MCS) with an approximate design capacity of 200 TPD_5, to convert solid waste generated by the communities of Oxford and Henderson into low-pressure steam is both technically feasible and economically viable. This sytem, which is located within the Oxford Industrial Park and sells competitively priced steam to one or more of the proximate industrial concerns, appears to be the most promising resource recovery option for the area.

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*The use of the term "200 TPD_5" refers to system with a design capacity of 200 tons per day (24 hours) on a 5-day-per-week basis.

- The economic and environmental benefits attributed to the 200 TPD_5 modular combustion resource recovery option appear highly favorable when compared to the disposal alternative of continued landfilling. Chief among the recovery option benefits are:

  - Stabilized and competitive disposal costs to the participating communities.

  - A cost-competitive and assured energy source for the participating industrial concerns.

  - An additional source of *ad valorem* tax revenues to the county.

  - The creation of approximately 12 high-paying industrial sector jobs.

  - Extension of the useful remaining life of the North Granville landfill.

  - An environmentally superior disposal practice which obviates securing a replacement for the Vance County landfill.

- Two other resource recovery options evaluated also appeared to be technically feasible: a 150 TPD_5 modular combustion system serving the disposal needs of Oxford and a 100 TPD_5 modular combustion system accepting waste from Henderson.

  However, the economic analysis indicated that neither of these options was likely to be cost-competitive with the disposal alternative of continued landfilling.

Secondary Findings

In addition to the above principal findings, secondary findings are:

- While both Oxford and Henderson currently enjoy modest landfill disposal costs reflecting efficient current operation, future disposal costs are expected to increase significantly due to inflationary factors and the required operation and capital improvements mandated by the Resource Conservation and Recovery Act (RCRA). The impact changes in landfill regulations is not reflected in the cost comparisons developed.

- While a preliminary market study indicated that there were several prospective customers interested in the concept of purchasing energy from a resource recovery project, this interest was both preliminary and cautious. For that reason, the true level of commitment must be established for each of the prospective cus-

tomers to ensure that in fact there will be an energy buyer if a project proceeds further.

- Availability of a site at the Oxford Industrial Park for a recovery facility appears to exist. Such a site would be within a reasonable steam transport distance of potential steam buyers.

Immediate Next Steps

The result of the Preliminary Feasibility Study of Resource Recovery for the Cities of Oxford and Henderson indicates that the necessary ingredients to a resource recovery project appear to exist.

However, three major tasks must be performed in order to verify the preliminary findings. These tasks also should be undertaken prior to the commitment of substantial resources to implement a resource recovery project. These immediate next steps are:

- Quantify the waste stream through a weighing program to ascertain that sufficient solid waste exists, the energy value of which is adequate to produce sufficient steam to satisfy the requirements of the potential energy buyers.

- Determine who controls the various portions of the waste stream and develop strategies and methods to assure that waste generated in the Oxford/Henderson area can be directed to an energy recovery facility.

- Ascertain the strength of interest expressed by the industrial concerns identified in the market survey as prospective energy customers. Perform more detailed evaluations of their respective energy practices and requirements, including detailed energy load profiles with hourly, daily and seasonal variations, as well as aggregate current and projected fuel costs, and electrical, water and other utility charges.

Other Project Considerations

If the results of the next steps are positive, the services of a consulting firm should be engaged to determine in detail the best recovery project. Such detailed feasibility will provide the basis for a go/no-go decision to proceed with determining how to put together the best project, including waste flow control, systems performance and definition, resolu-

tion of the best approach to managing and minimizing risks and uncertainties, and the method of systems procurement and financing, and preparation and issuance of procurement documents.

Other considerations which sponsors of a resource recovery project serving the Kerr-Tar region should be aware of before committing to the implementation of a resource recovery project are:

- A substantial portion of the available solid waste stream will require ultimate landfill disposal even if resource recovery is implemented. This portion may be as high as 35 percent on a tonnage basis (but only 10-20 percent on a volume basis, which is the critical measure for determining landfill requirements). This proportion is comprised of oversized bulky materials and non-combustibles which are intentionally diverted as well as residual materials remaining after combustion.

- The lead times for a resource recovery project are significant. For a project involving the modular combustion system, a typical timeframe for implementation following formal contract signing is a minimum of 24 months. This time frame suggests mid-1983 as earliest date by which a system would likely be fully operational.

- Until recently, industry viewed resource recovery primarily as a lower quality, less reliable energy supply option, and expected the price of the energy product to reflect this opinion. This perspective is just beginning to change, with industrial concerns now recognizing that resource recovery offers energy self-sufficiency for system energy customers.

- Solid waste officials and citizenry should treat the estimated 37,000 tons of solid waste generated annually in the Kerr-Tar region as an energy resource for which fair value should be received as the result of any transaction with a buyer. Such a perspective differs substantially from that which views resource recovery as a method of mitigating the problem of disposing of solid waste.

- Implementation of a resource recovery project can enhance the progressive image of the Oxford/Henderson area, thus enhancing the ability to attract new industry to the region.

STUDY METHODOLOGY

The analytic approach utilized in the preliminary feasibility study reflects the fact that implementation of (energy) resource recovery depends upon the presence of the following five basic ingredients:

- *Available Solid Waste* -- That sufficient solid waste tonnage of a combustible nature is generated by, and available from participating communities.

- *Potential Energy Customers* -- That prospective energy customers can be found whose current and projected energy requirements are compatible with the energy which can be produced from a recovery facility.

- *Appropriate Sites* -- That an available site can be secured on which to locate a resource recovery project, and which is within reasonable steam transport distance of an energy buyer.

- *Compatible Technologies* -- That appropriate technologies exist to convert the available solid waste materials into an acceptable energy form for the previously identified energy customers.

- *Competitive Economics* -- And, finally, that the economics of resource recovery result in a competitively priced energy product for the system's energy customers and net disposal costs to the participating communities which are competitive with the disposal option. of continued landfill.

The specific approach taken to determine the existence of each of the above basic ingredients and the resultant findings and conclusions are described in the following sections.

Available Solid Waste

An accurate assessment of the quantity and characteristics of the solid waste stream must be made to determine whether there is sufficient combustible material available to support a resource recovery project. This assessment requires that a waste characterization be performed including detailed weighings and samplings. However, such a program must cover a lengthy time period in order to determine seasonal variations in waste generation; and requires the expenditure of additional funds and could ultimately result in wasted effort, if other necessary basic ingredients are later found not to exist. As a consequence, an alternative

and preliminary waste verification strategy was devised. Volume estimates of the solid waste available at the two County landfills were first converted to tonnage estimates utilizing conservative per-cubic-yard density factors and then verified for reasonableness by comparison against U.S.E.P.A. rule-of-thumb per-capita waste generation estimates.

As the approximate quantity of waste projected under the methodology initially appeared to be sufficient to support even the largest MCS option, subsequent analysis focused on determining whether the lack of other basic ingredients would render resource recovery unfeasible. Because all other ingredients were found to exist, then subsequent to a more detailed feasibility study a waste characterization should be performed to verify accurately the quantity and characterization of the solid waste stream.

Potential Energy Customers and Appropriate Sites

An extensive market survey was performed to determine whether prospective customers exist who are interested in purchasing the energy product and whose location and current and projected energy practices are likely to be compatible with demonstrated resource recovery technologies. A search for potential available sites of adequate acreage suitably located was performed in parallel with the energy market survey.

From the extensive energy market survey there emerged several prospective energy customers whose location, energy practices, and requirements and preliminary interests indicated that they could be considered further as potential customers for the energy of fuel produced by a resource recovery system, accepting waste from one or more of the region's major cities.

The findings of the Appropriate Site Search Task indicated that two sites exist that are likely to be available and are of sufficient acreage and appropriately located to accommodate an MCS resource recovery system.

One site identified is within the Oxford Industrial Park, adjacent to the existing Cristex Corporation facility, and the second site is off Route 1 to the rear of the Americal Corporation.

Appropriate Technology

The estimated quantity of combustible solid waste available and the energy requirements and practices of the prospective customers dictate both the scale of the resource recovery system and the energy from produced. These parameters thus define the technology of the resource recovery options as small scale modular combustion systems. A match of the energy requirements of the prospective system customers with the one compatible and demonstrated technology resulted in three resource recovery options for the cities of Oxford and Henderson.

These follow:

- 200 TPD_5 MCS located at the Oxford Industrial Park, accepting waste from both Oxford and Henderson, producing steam for sale to Cristex and others.
- 150 TPD_5 MCS located at Oxford Industrial Park, accepting waste from Oxford, producing steam for sale to Cristex.
- 100 TPD_5 MCS located off Route 1 in Henderson, accepting waste from Henderson, producing steam for sale to Americal.

Competitive Economics

The economic viability of a given resource recovery option was determined by comparing the projected net disposal costs resulting from this option with the disposal alternatives -- in this case, continued landfilling.

First-order economics reflecting estimated system capital costs, debt service, operational expenses and resultant net disposal projections were developed for each resource recovery option, based on mid-1983 operations.

The projected net disposal costs for each resource recovery option were then compared with the alternative of continued landfilling to determine economic feasibility. The following table compares the resultant net disposal cost projections with the cost of continued landfilling:

Disposal/Resource Recovery Option	Projected per Ton 1983 Net Disposal Costs
200 TPD_5 MCS	$5.50
Continued Landfilling	$5-$6.00
150 TPD_5 MCS	$11.50
100 TPD_5 MCS	$19.50

As can be seen from the above table, of the three resource recovery options evaluated only the 200 TPD_5 MCS projects a net disposal cost competitive with the 1983 estimated cost of the disposal alternative of continued landfilling.

APPENDIX A

ENERGY MARKET SURVEY FINDINGS

POTENTIAL ENERGY CUSTOMERS LOCATED AT
OXFORD INDUSTRIAL PARK

COMPANY	HOURLY STEAM REQUIREMENTS	STEAM QUALITY	OPERATIONS
Bandag	6000-8000 LBS	250 PSIG	5 d/week 24 h/day (3 shifts)
Certainteed	6500-7500 LBS	125 PSIG	5 d/week 16 h/day (2 shifts)
Cristex	7000-30,000 LBS	125 PSIG	7 d/week 24 h/day (3 shifts)
General Processors	10,000-20,000 LBS	120 PSIG	5-6 d/week* 24 h/day (3 shifts)
Ideal Fasteners	3000-4000 LBS	90 PSIG	5 d/week 16 h/day (2 shifts)

*6-7 months per year.

BANDAG CORPORATION

Contact: Virgil King, Plant Manager
(919) 693-8855

William Leehr, Senior Facilitites Engineer (Corporate)

Background:

Bandag is located within the Oxford Industrial Park. It has operated at this facility since 1968. This facility produces tire casings and pre-cured treads which are sold to various tire recappers as well as to original equipment manufacturers. This is one of six domestic operations. As well, there are five existing and two projected foreign operations. The plant typically operates five days per week, 24 hours per day.

Solid Waste Practices:

The primary waste product generated in the manufacturing process at Bandag is the various rubber strippings which are a waste product from the manufacturing process. It is estimated that approximately 500 tons per year, (1,000,000 lbs per year) of various rubber waste products are generated. As well, there are occasional pallets and small quantities of cardboard, polyfilm and other waste products typical of manufacturing processes. Solid waste disposal costs currently run about $3500 per month, or between $40 and $50 thousand per year. Waste Industries, a private waste hauler, collects the waste for disposal in the landfill.

Energy Practices:

Steam is utilized in the manufacturing process at 250 psig. The existing boiler complex has a capacity of 250 hp or 8750 lbs of steam per hour. Steam is typically produced five days per week, 24 hours per day, and is used primarily for process applications. There is a small seasonal variation in steam demands.

The current fuel source is interruptible natural gas with Number 2 oil as the backup fuel. Current fuel costs are projected at $3 per million Btu's, which is equivalent to approximately $4.06 per thousand lbs of 250 psig steam.

Implications for Resource Recovery:

Bandag is very much interested in the concept of resource recovery, including that of purchasing steam from an outside producer. Corporate had recently investigated the possibility of utilizing internally generated waste to fire in waste boilers. Bandag evaluated a small waste package boiler soliciting quotes from Consumat, ECP and Sunbeam, but concluded that because of the high capital cost and the limited quantities of waste generated, this approach was not cost effective.

For small scale capital investment projects Bandag utilizes a simple before-tax payback investment criteria, with a payback period of 2 or less years typically required. The feasibility of larger investments is analyzed on an after-tax basis, with a 10% cost of capital assumed in determining ROI (Return on Investment). Employee welfare and environmental considerations are also weighted in the analysis in the case of either small or large scale investments.

Because of its interest in the concept of resource recovery and its location within the industrial park, and due to its 24-hour-per-day operation, Bandag should certainly be considered further as a potential customer for the steam produced by a contiguously located resource recovery system.

CERTAINTEED COMPANY

Contact: Raymond Joy, Plant Engineer
(919) 693-1141

Background:

Certainteed is one of the 11 industries currently located within the Oxford Industrial Park. This concern produces roofing products, including asphalt shingles, tar paper and construction grade papers. This facility is two years old and operates five days per week, two shifts per day. Production is limited to five days per week due to the nature of the process. Extensive housekeeping and maintenance is done on the one or two days per week (weekends typically) when the plant is not operating.

Solid Waste Practices:

Certainteed is a substantial generator of various solid waste products resulting from its manufacturing processes. Nearly 45 tons per day of various products are generated, based on 22 working days per month. These products include the followi :

- 750 tons per month asphalt shingle pr s in the form of about six inch long and ¼ inch to ½ wide shavings or trimmings;
- 150 tons per month saturated (tar) roofin er; and
- 114 tons per month unsaturated roofing pape .

Energy Practices:

One-hundred twenty-five psig steam is produced by two Cleaver-Brooks 15,000-lb capacity package boilers. Approximately 53 percent of the energy is required for boiler applications and producing steam, 15 percent is directed towards process heaters, 9 percent for filler heaters, and the remaining 23 percent is utilized in the two incinerators which operate to collect and burn the various gases arising from this process. August 1979 production of steam was approximately 2,300,000 lbs per month which is approximately equivalent to 6500 lbs per hour. It is estimated that the steam load is reasonably

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constant whenever operating. Winter demand for steam increases approximately 10 percent.

The Number 6 fuel is low-sulfur content and is supplied by Chevron and Swan Oil Corporations. Number 6 fuel oil is used to produce both steam as well as for direct heating applications to keep the various raw materials heated before introduction to the manufacturing process. Approximately 800,000 gallons of fuel oil were consumed last year out of Norfolk, Virginia under a corporate purchasing policy. The most recent price for this oil is about $50 per gallon.

Implications for Resource Recovery:

Certainteed currently recovers portions of the various waste gas released during the manufacturing process. These gases are condensed and collected and later blended with the Number 6 oil. Particulates from this gas process are removed via electrostatic precipitators. Certainteed is interested in the concept of resource recovery, particularly in the concept of RDF, and would like to know if the substantial quantity of asphalt shingles, which comprise 40 percent asphalt and 60 percent limestone, might be utilized as an enricher and/or binding agent for RDF. Mr. Joy sees problems with producing steam for sale to Certainteed because of its modest steam requirements and because the bulk of its energy requirements are in the form of direct heat applications.

CRISTEX CORPORATION

Contact: William Coulter, Plant Engineer (Mr. Coulter has just begun work at Critex, having been there less than one month. Previously he was plant engineer at an H.J. Hanes facility).
(919) 693-6141

Background:

The Cristex facility is located in the Oxford Industrial Park. Operating since 1965 at this site, there are currently approximately 225 employees. The Cristex Corporation manufactures acetate and nylon warp knit products. Current operations are 5 days per week on a three-shift basis, or 6 days per week on a two-shift basis.

Solid Waste Practices:

For an operation of this size there is a surprisingly modest amount of solid waste material. Most of the waste that is generated is non-combustible; it is baled carpet waste product. There is also a small amount of cafeteria-type and office waste materials. There is also a small quantity of waste oil which is recovered for reuse.

Energy Practices:

Two 600-hp boilers are utlized to produce 125 psig steam. Steam is used for heating of the water for dyeing purposes, and for climate control in the various knitting rooms. During the wintertime steam is also used for comfort heating purposes. While the plant operates 5 to 6 days per week, depending on the number of shifts, one of the boilers operates 7 days per week to provide steam to maintain climate control in the knitting rooms. On the weekend, when the plant is not operational, the steam load is approximately 30% of one boiler, or approximately 6500 lbs of steam per hour. During peak times both boilers operate at between 75%-80% capacity, suggesting a peak steam requirement in excess of 30,000 lbs of steam per hour.

The plant does not have a stationary engineer, whose sole purpose is the maintenance and operation of the boilers. Exact steam metering information is not available, as various meters have not worked for some time. One of the first assignments that Mr. Coulter has undertaken is to get the steam meter devices reparied, so that an accurate fuel and steam usage and cost can be determined.

Natural gas on an interruptible basis is currently utilized, with No. 6 oil being the backup fuel. No. 6 oil, with a maximum 2.5% sulfur content, currently cost 48.5¢ for Cristex.

Implications for Resource Recovery:

Mr. Coulter is very much interested in the concept of resource recovery, particularly as it can reduce the steam cost for the Cristex facility and also minimizes dependence on non-renewable resources. He is currently trying to determine what the actual costs of producing steam are for the Cristex facility, taking into consideration fuel cost, maintenance, labor and other indirect expenses, as well.

Because of the ideal location within the Oxford Industrial Park, where there is a tremendous amount of available acreage, and because the facility is likely to require steam on an around-the-clock basis, 7 days per week, ranging from a low of 6,000 lbs on weekends to as much as 30,000 lbs furing the week, Cristex Corporation should be considered as an attractive potential customer for low-pressure steam produced by a modular resource recovery system located contiguously.

GENERAL PROCESSERS

Contact: James Lumpkins, General Manager
(919) 693-1116

Background:

General Processers is a tobacco processing and redrying concern. Located in the Oxford Industrial Park since 1975, General Processers is owned by two companies -- W. A. Adams and Tobacco Trade (both based in Oxford). Typical of the tobacco processing industry, General Processers operates about 6 to 7 months per year, from about mid-July to early March.

Solid Waste Practices:

General Processers generates a large quantity of non-combustible type waste comprised of dirt and dust materials, which is liberated from the tobacco as it is injected with steam and subsequently dried. This material is collected and transported by augur-type screw conveyers to holding bins. The bins are periodically dumped into an open-type truck for delivery to the landfill. One full-time employee is devoted to removing the dirt (as well as a small amount of co-mingled combustible waste).

Energy Practices:

Two 500-hp capacity boilers produce low-pressure steam at 120 psig for injection and drying processes. During the processing season, the plant typically works 5-1/2 days per week at 24 hours per day. During this period the boilers produce steam at ranges from about 10,000 to 20,000 pounds per hour (300 to 600 hp).

Number 4 oil with a sulfur content of less than 2.5% is currently used, with interruptible natural gas as the alternative fuel.

Implications for Resource Recovery:

Mr. Lumpkins says that General would be interested in purchasing low-pressure steam from a contiguously located resource recovery facility, were the pricing determined to be competitive by the corporate decisionmakers. However, the seasonal nature of this concern's operations, as well as the hourly variability in its steam demand, could make the

economics of selling steam to this customer questionable. Nonetheless, General Processers should be considered further as a potential energy customer for steam.

IDEAL FASTENER

Contact: Glynn Thomas, Plant Engineer
(919) 693-3115

Background:

Ideal Fastener produces zippers of all different types. Located in the Oxford Industrial Park, this facility has operated since 1966 and employs approximately 220 employees. Operations are approximately five to six days per week, with two shifts daily. Operations are limited to two shifts daily because the bulk of the work force is women and Ideal finds it difficult to recruit women employees for the third shift.

Solid Waste Practices:

Various metal waste products resulting from the stamping processes necessary to make zippers are recovered for sale to various scrap dealers. The remaining waste is typical of other light manufacturing processes, and is limited to cafeteria waste, occasional rejected materials and tape, cotton and synthetic fibers, as well as occasional pallets and wood waste spools (plywood), which weigh approximately 20 to 30 lbs each. The quantity of solid waste generated is modest.

Energy Practices:

A 125-hp capacity boiler (4375 lbs of steam per hour) produces 90 psig steam for process applications and heating and cooling. Natural gas is purchased on an interruptible basis. Typical steam requirements are approximately 2500 to 3000 lbs of steam per hour.

Implications for Resource Recovery:

Because of its modest steam requirements as well as its five-day-per-week, two-shift operation, Ideal Fastener should not be considered as a primary customer for the steam produced by a contiguous resource recovery system. However, because it has expressed some interest in the concept of purchasing steam and is located in Industrial Park, surrounded by other larger energy consumers, Ideal Fastener could be considered as a secondary or tertiary customer purchasing modest amounts of steam as available.

HENDERSON POTENTIAL ENERGY CUSTOMERS

COMPANY	HOURLY STEAM REQUIREMENTS	STEAM QUALITY	OPERATIONS
Americal	± 20,000 LBS	125 PSIG	5 d/week 16 h/day (2 shifts)
JP Taylor	30,000- 50,000 LBS	125 PSIG	5 d/week 20 h/day (2 shifts) 7-8 months
Nu Southern Dyeing & Finishing	20,000- 30,000 LBS	125 PSIG	T: 6 d/week 24 h/day (3 shifts) C: 5 d/week 12 h/day (1½ shifts)

AMERICAL CORPORATION

Contact: Allan J. Buckreus, Vice President, Manufacturing
(919) 492-2166

Background:

The Americal Corporation is located on Route 1 just south of Henderson. This facility is a contract manufacturer of ladies hosiery and pantyhose. Hosiery are manufactured, dyed and packaged to specification for approximately 200 large private label accounts such as Zayres, K-Mart, and J.C. Penny. The company is 11 years old, and has other facilities at Chattanooga, Tennessee and Goldsboro, North Carolina. It is the third largest ladies hosiery company in the world.

The Henderson facility operates 16 hours per day (two shifts), five days per week for the dyeing and packaging operations, and three shifts per day for the knitting operations. Women constitute the majority of employees, and because of the difficulty in attracting women for the third shift, the facility limits its operation mainly to two shifts per day.

Solid Waste Practices:

Substantial quantities of cardboard products are generated at this facility as well as occasional wooden spools and cafeteria-type waste. Solid waste is collected by one of the local haulers at a cost of approximately $200 per week.

Energy Practices:

Two boilers—one a 300-hp boiler and the other, a 350-hp boiler—(combined capacity of approximately 22,950 lbs per hour) are utilized to produce both steam at 125 psig and hot water at approximately 170 F for dyeing and drying applications within this facility.

The current boilers have been operating at 104 percent capacity two shifts per day. Plans are being made to replace one of these existing boilers, so that steam production will be at a more comfortable range.

Natural gas on an interruptible basis is the fuel used. The company also has 17,000 gallons of oil in underground storage, which was

bought last year at 42¢ per gallon and will probably be sold. August consumption of gas was approximately $12,000 worth.

Current cost of the natural gas is approximately $2.87 per million But's, equivalent to about $3.88 per thousand lbs of steam.

Implications for Resource Recovery:

Americal seems interested in the concept of resource recovery, particularly in view of the fact that they are making plans to replace one of their existing boilers. There does appear to be available land approximate to the Americal facility.

At present Americal is also looking into the possibility of being able to recycle the hot water used in its manufacturing process, which could substantially reduce their energy requirements. The exact nature of this recycling process was not revealed. The nature of this recovery process is based upon being able to remove the contaminants from the water which previously was utilized to dye the various materials.

Approximate steam requirement of 20,000 lbs per hour could support an approximately 70-ton per day facility. However, it may prove to be a 70-ton per day facility is outside of the reasonably economic size range for a small-scale resource recovery system.

Nonetheless, because of its expressed interest in resource recovery and due to its substantial hot water and steam requirement and the availability of vacant land contiguous to this facility, Americal Corporation should be considered as a potential customer for steam produced from a small-scale modular resource recovery system.

BURKART-RANDALL

Contact: Eudell Webb (Mr. Webb will be leaving effective 14 September, to take a job in Blytheville, Arkansas.)
(919) 438-6111

Background:

The Burkart-Randall operation is a division of Textron Industries located on Route 1, just south of Henderson. This facility is approximately 1/2 to 3/4 mile southeast of the J.P. Taylor operation. This facility manufactures non-woven fabric for carpet underlay to the automobile industry and recently has operated six to seven days weekly, 24 hours per day.

Solid Waste Practices:

Various fibrous material in dust form is collected from the manufacturing process and prior to disposal. It is estimated that 120 cubic yards per week are generated. This material is comprised of nylon and/or cotton, and is hauled away by a private waste hauler.

Energy Practices:

The manufacturing operation consists of shredding and blending various scrap materials and then introducing an acrylic latex into one of seven gas-fired ovens. These ovens are 700 feet long and are fast-drying, with temperatures ranging from 325^{o} to 425^{o} Fahrenheit. The material moves approximately 18 to 30 feet/minute. During the summer space cooling is provided by electricity at a cost estimated to be approximately $20,000/month. Approximately 150,000 of the 265,000 square feet that encompass the facility are cooled during the summer. During the winter waste heat is captured from various ovens to maintain comfort heating.

Implications for Resource Recovery:

Because the manufacturing process employed at Burkart-Randall requires direct heat applications, it is unlikely that the steam product from a resource recovery system could realistically replace the natural gas currently used in the various furnaces and driers. Thus it appears unlikely that a resource recovery facility could

serve Burkart-Randall as a major energy customer. It is possible, however, that space cooling requirements during the summer could be converted to chilled cold water probably requiring less than 10,000 lbs of steams per hour. This approach would be feasible only in the event that J.P. Taylor were the primary customer with Burkart-Randall receiving a portion of the unutilized steam during the summer months when Taylor was not generating.

LAURENS GLASS

Contact: Dennie House, Vice President, Manufacturing (Corporate)
Mr. House is located at the Corporate facility in Laurens, South Carolina
(803) 984-2541

Background:

The Laurens Glass facility is located on Route 1, just south of Henderson. Laurens Glass manufactures a wide range of glass containers, including beverage bottles, etc.

Energy Practices:

Natural gas is a primary fuel utilized to heat kilns and melt glass. Substantial quantities of waste heat are generated in the process and captured in the form of hot water at 150° F. This water is then pumped to one of two heating towers. After cooling down to approximately 70° F, the water is recycled back into the manufacturing process.

Implications for Resource Recovery:

Because Laurens Glass has a surplus of waste heat in the form of hot water, and uses natural gas as its primary fuel, it is unlikely that this company could utilize the energy produced from a contiguously located resource recovery system.

While it is outside the scope of CSI Resource Systems' current feasibility study effort, local solid waste decisionmakers might consider evaluating the feasibility of Laurens' bypassing the cooling phase (which is an energy-consuming step) and providing hot water to one of the nearby industries which uses steam or hot water, in exchange for cooler makeup water. At today's energy prices the value of 150° F water exceeds $2.60 per thousand gallons.

NU SOUTHERN DYEING CORPORATION

Contact: Caryle Morris, Plant Engineer
(919) 438-7101

Background:

The Nu Southern operation is located on the western outskirts of Henderson. This company has been in operation since 1963 and has 125 employees. Nu Southern Dyeing is (in the words of Mr. Morris) a glorified laundry, or a commissioned dyer. The company takes possession of materials owned by other textile concerns and dye them to various colors and specifications as required. This industry is referred to as a dyeing and finish industry and is highly competitive.

Operations currently are 5 days per week, approximately 12 hours per day. The targeted operational figure is 6 days per week, 24 hours per day. However, the industry is very cyclical and because of almost overnight fluctuation it is difficult to plan operations.

Solid Waste Practices:

There is surprisingly little solid waste generated by this manufacturing process. It is estimated that there are approximately two truckloads per week, or less than 10 tons a week of waste material, including woolly rags, cafeteria-type waste and office waste materials.

Energy Practices:

Steam at 125 psig as well as hot water at 175^{o}F is utilized in the manufacturing process in the dyeing of the various materials. Steam demand ranges from 20,000-30,000 lbs per hour and is generated by one of three boilers. Boilers include a 1975 Cleaver-Brooks 1200-hp, a 1955 Babcock & Wilcox 250-hp, and a 1955 200-hp Wicks.

Natural gas is currently used on an interruptible basis and has been available for the past year. Previously No. 6 oil with less than 2% sulfur content was utilized. Because of fluctuations in steam requirements within an hourly period ranging from as much as 5,000-20,000 tons perhour, a stationery engineer is required around the clock. Current costs for a stationery engineer ranges from $20,000 to $30,000 per year. Dyeing operations typically do have a fluctuating steam load.

Implications for Resource Recovery:

While Nu Sourthern Dyeing is extremely interested in the concept of purchasing steam from a contiguously located resource recovery facility, several problems remain. First, is the issue of the cyclical nature of the dyeing industry, where in one week they may be operating 6 days per week, 24 hours per day, and in the next week substantially below capacity. The second issue is the fluctuating steam requirements. Steam requirements may range from 5,000 to 30,000 lbs over an hourly basis.

Third, there could be some difficulty in locating a site nearby, although there appears to be land several hundred yards away on the site of an old Universal Leaf Tobacco complex, which is now for sale.

On the other hand, the advantages of a resource recovery facility would be to provide steam as required and eliminate the necessity for, three highly paid, competent stationary engineers.

Nu Southern should remain as a possible candidate for a resource recovery facility, but there appears to be other more promising customers located in Henderson.

J.P. TAYLOR CORPORATION

Contact: Thomas P. Rodwell, Plant Engineer
(919) 492-1161

Background:

J.P. Taylor is a tobacco processing concern, a division of Universal Leaf Tobacco, which is based in Richmond, Virginia. The Henderson facility, located off of Route 1-A (the Raleigh Road), south of Henderson, is one division of the largest tobacco processor in the world. The tobacco processed at this facility is primarily for export markets. Last year this facility operated only 5 months. In a typical year, however, while there are seasonal operations aspects, this facility would normally range from 7 to 10 months. Tobacco processors typically do not operate during April, May, June, July and the first half of August. This facility has operated in Henderson since 1961.

Tobacco in its raw form is delivered to this facility, and is processed by injecting steam on a periodic basis into the tobacco, and thereafter dried in steam driers. A recent improvement to this facility added another 45,000 square ft (300 by 150 ft), allowing the facility to nearly double its processing capability.

Solid Waste Practices:

Solid waste is hauled to the city dump by J.P. Taylor employees in its own truck. There is one employee who is wholly dedicated to delivering waste to the dump. The bulk of this waste is non-combustible type of dirt and other contaminating material removed from the leaf material during processing. As well, there is canteen-type waste and a small amount of combustible waste. The truck that delivers this waste to the Henderson landfill is a 24-yard truck.

Energy Practices:

The boiler plant consists of three 600-hp boilers and one 350-hp boiler with a peak steam capacity of approximately 75,000 lbs of steam per hour. Steam at 125 psig is utilized in the manufacturing process; 175^{o} F hot water is used in the drying process. Driers are approximately 120 ft long. During a typical winter day, the heating requirements increase the

steam demand by an amount equivalent to the capacity of one 600-hp boiler.

Number 6 oil, at 2.5 percent sulfur content, is utilized in this facility. Current prices are approximately 50¢ per gallon. Management is looking into the possibility of converting to natural gas on an interruptible basis. While this cost is not likely to be substantially cheaper (approximately 5 to 10 percent), there are advantages to utilizing natural gas, including less boiler maintenance.

Implications for Resource Recovery:

Mr. Rodwell, the plant engineer indicated interest in the concept of utilizing steam provided by a contiguously located resource recovery facility. However, further decisions on this would have to be made on the corporate level. The individual to speak to at the corporate level is the Chief Engineer and Vice President, Mr. Dean Cheatham, Jr., at Universal Leaf Tobacco in Richmond, Virginia.

Due to the seasonal aspects of the General Tobacco facility, some difficulties are presented. Typical operations during the operational season are either two 10-hour shifts, five days per week, or three 7½-hour shifts, five days per week. However, because the steam requirements of J.P. Taylor Corporation are likely to exceed the production from a resource recovery facility when it is operating, further research should be done to try to determine whether other customers in a nearby situated industrial park could be recruited as potential customers for steam on an interruptible basis during these periods of time when the J.P. Taylor Corporation is not operating.

APPENDIX B

ECONOMICS OF RESOURCE RECOVERY OPTIONS

PROJECTED 1983* ECONOMICS FOR 200 TPD_5 DESIGN CAPACITY MODULAR COMBUSTION SYSTEM (145 TPD_5 AVERAGE THROUGHPUT)

ANNUAL SOLID WASTE THROUGHPUT		37,700
ANNUAL ENERGY PRODUCTION (lbs. of steam)		188,000,000
ANNUAL ENERGY SALE (lbs. of steam)		170,000,000
OPERATION COSTS:	(Annual Basis)	(Per Ton Basis)
Debt Service	$ 635,000	$17.00
Labor[7]	230,000	6.00
Maintenance and Replacements	200,000	5.00
Utilities	100,000	2.50
Residual Disposal[8]	75,000	2.00
Taxes	40,000	1.00
TOTAL OPERATING COSTS	1,280,000	34.00**
LESS ENERGY REVENUES	1,070,000	28.50**
NET DISPOSAL COSTS	210,000	5.50**

* Mid 1983

** Due to rounding of cost elements totals are not exact.

PROJECTED 1983* ECONOMICS FOR 150 TPD_5 DESIGN CAPACITY MODULAR COMBUSTION SYSTEM ($90\ TPD_5$ AVERAGE THROUGHPUT)

ANNUAL SOLID WASTE THROUGHPUT		23,400
ANNUAL ENERGY PRODUCTION (lbs. of steam)		117,000,000
ANNUAL ENERGY SALES (lbs. of steam)		105,000,000
OPERATING COSTS:	(Annual Basis)	(Per Ton Basis)
Debt Service	$530,000	$23.00
Labor[7]	205,000	9.00
Maintenance and Replacements	120,000	5.00
Utilities	60,000	2.50
Residual Disposal[8]	45,000	2.00
Taxes	35,000	1.50
TOTAL OPERATING COSTS	995,000	43.00**
LESS ENERGY REVENUES	735,000	31.50**
NET DISPOSAL COSTS	260,000	11.50**

* Mid 1983

** Due to rounding of cost elements totals are not exact.

PROJECTED 1983* ECONOMICS FOR 100 TPD_5 DESIGN CAPACITY MODULAR COMBUSTION SYSTEM ($70\ TPD_5$ AVERAGE THROUGHPUT)

ANNUAL SOLID WASTE THROUGHPUT		18,200
ANNUAL ENERGY PRODUCTION (lbs. of steam)		91,000,000
ANNUAL ENERGY SALES (lbs. of steam)		82,000,000
OPERATING COSTS:	(Annual Basis)	(Per Ton Basis)
Debt Service	$465,000	$25.50
Labor[7]	205,000	11.50
Maintenance and Replacements	90,000	5.00
Utilities	45,000	2.50
Residual Disposal[8]	35,000	2.00
Taxes	30,000	1.50
TOTAL OPERATING COSTS	870,000	48,00**
LESS ENERGY REVENUES	515,000	28.50**
NET DISPOSAL COSTS	355,000	19.50**

* Mid 1983

** Due to rounding of cost elements totals are not exact.

PROJECTED 1983* CAPITAL COSTS FOR 200 TPD_5 DESIGN CAPACITY MODULAR COMBUSTION SYSTEM ($145\ TPD_5$ AVERAGE THROUGHPUT)

CAPITAL COST COMPONENTS:	
Site acquisition and development	$ 130,000
Building[1]	960,000
Combustion subsystems[2]	4,500,000
Mobile equipment	120,000
Start-up, acceptance and contingency[3]	570,000
Engineering and construction management[4]	450,000
Bond financing[5]	220,000
Debt Reserve and Capitalized Interest[6]	635,000
TOTAL BOND ISSUE	7,600,000**

* Mid 1983

** Due to rounding of cost elements total is not exact.

PROJECTED 1983* CAPITAL COSTS FOR 150 TPD_5 DESIGN CAPACITY MODULAR COMBUSTION SYSTEM ($90\ TPD_5$ AVERAGE THROUGHPUT)

CAPITAL COST COMPONENTS:	
Site acquisition and development	$ 130,000
Building[1]	840,000
Combustion subsystems[2]	3,700,000
Mobile equipment	80,000
Start-up, acceptance and contingency[3]	475,000
Engineering and Construction Management[4]	370,000
Bond financing[5]	190,000
Debt Reserve and Capitalized Interest[6]	530,000
TOTAL BOND ISSUE	6,320,000

* Mid 1983

** Due to rounding of cost elements total is not exact.

PROJECTED 1983* CAPITAL COSTS FOR 100 TPD_5 DESIGN CAPACITY MODULAR COMBUSTION SYSTEM ($70\ TPD_5$ AVERAGE THROUGHPUT)

CAPITAL COST COMPONENTS:	
Site acquisition and development	$ 130,000
Building[1]	785,000
Combustion subsystems[2]	3,200,000
Mobile equipment	80,000
Start-up, acceptance and contingency[3]	410,000
Engineering and Construction Management[4]	320,000
Bond financing[5]	165,000
Debt Reserve and Capitalized Interest[6]	465,000
TOTAL BOND ISSUE	5,550,000**

* Mid 1983

** Due to rounding of cost elements total is not exact.

ASSUMPTIONS

1. Btu content of MSW = 4500/LB

2. Operating efficiency of system = 65%

3. 5000 LBS of 125 PSIG steam / input solid waste ton

4. Available combustive waste from Henderson and Oxford = 145 TPD_5 (tons per 5 day week)

5. Energy revenues predicated upon:
   - 1982 cost of #6 of 75¢ / gallon
   - 9.33 gallons of #6 oil = 1000 LBS of 125 PSIG steam
   - value of steam = $7.00 / 1000 LBS
   - 90% of steam produced is sold
   - customers are given an initial 10% discount on equivalent fuel value of steam ($6.30/1000) as an incentive to sign a long term contract
   - pricing of steam in subsequent years is tied to the cost of alternative fuel #6 oil with appropriate discounts

6. Debt service based on 20 year financing at 5.5%

FOOTNOTES

[1] Building costs at 40/ft
24,000 ft^2(150 x 160) for 200 TPD_5 MCS
21,000 ft^2(140 x 150) for 150 TPD_5 MCS
19,600 ft^2(140 x 140) for 100 TPD_5 MCS

[2] Includes steam line of 250 ft at $100 ft.

[3] 10% of site development, building, combustion subsystem and mobile equipment costs.

[4] 8% of site development, building and combustion subsystem costs.

[5] Bond financing costs estimated at 3% of bond issue.

[6] Debt reserve and capitalized interest equivalent to estimated 1 year's debt service expense.

[7] 12 Employees for 200 TPD_5 MCS;
10 Employees for 150 TPD_5 MCS and for 100 TPD_5 MCS

[8] Residuals approximate 20% by weight of input solid waste.

PERSONNEL REQUIREMENTS FOR 200 TPD_5
MODULAR COMBUSTION SYSTEM

Position	Number of Employees	Employee Salary	Subtotal
Plant Manager	1	$24,000	$24,000
Scale Operator	1	12,500	12.500
Operators	6	12,500	75,000
Shift Managers	2	18,000	36,000
TOTAL EMPLOYEES	12		
DIRECT LABOR EXPENSES			$147,500
FRINGE EXPENSES (@ 33%)			48,700
TOTAL LABOR EXPENSES			$196,200
PROJECTED 1983 LABOR EXPENSES [@ $(108\%)^2$]			$228,850

PERSONNEL REQUIREMENTS FOR 150 AND 100 TPD_5 MODULAR COMBUSTION SYSTEMS

Position	Number of Employees	Employee Salary	Subtotal
Plant Manager	1	$24,000	$24,000
Scale Operator	1	12,500	12,500
Operators	4	12,500	60,000
Shift Managers	2	18,000	36,000
TOTAL EMPLOYEES	10		
DIRECT LABOR EXPENSES			$132,500
FRINGE EXPENSES (@ 33%)			43,750
TOTAL LABOR EXPENSES			$176,250
PROJECTED 1983 LABOR EXPENSES [@ $(108\%)^2$]			$205,550